

Bone Fractures in Ibn Sina's Medicine

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Short link

by: Abdul Nasser Kaadan Ibn Sina, or Avicenna as he referred to in the West, was a well-known philosopher and physician from Islamic civilisation. Here we look at his accomplishments and contributions towards knowledge of bone fractures.



First page of Al-Qanun by Ibn Sina

Ibn Sina, or Avicenna as he is referred to in the West, was born in the year 980 CE in Afshana near Bukhara, Turkestan - now named Uzbekistan. He left Bukhara when he was 21 years of age, and spent the remainder of his life in various towns in Persia. When he died in the year 1037, he was acclaimed as one of the greatest philosophers in Muslim civilisation. In Medicine he was highly regarded and was compared to Galen, so came to be celebrated as the Galen of Islamic civilisation. Owing to his great celebrity, many nations competed to celebrate his anniversary. The Turkish were amongst the first who revived his anniversary in 1937, upon which they held a grand meeting to mark the occasion of nine hundred years since his death. This gesture was followed by various bodies in the Arab world alongside from Iran which held two festivals; one in Baghdad in 1952; followed by one in Tehran in 1954. To appreciate his contributions in developing the philosophical and medical sciences, in 1978 UNESCO invited all its members to celebrate the anniversary of one thousand years since his

birth. All members participated in the celebration, which was held in 1980.

Ibn Sina composed 276 works; all of them written in Arabic withstanding a few books written in his mother tongue, Persian. Unfortunately, most of these works were lost, however there are still 68 books or treatises available in Eastern and Western libraries. Though he seemed to be more interested in philosophy and medicine, he composed works in all branches of science. Several contemporary historians consider him as a philosopher more than a physician, whilst others consider him as a “prince of the physicians” during the Middle Ages.

The classification of Ibn Sina's works according to their contents is as follows:

43 works in medicine, 24 in philosophy, 26 in physics, 31 in theology, 23 in psychology, 15 in mathematics, 22 in logic, 5 in the interpretation of the Qur'an. Additionally, he wrote many treatises in asceticism, love, music as well as some stories.

Al-Qanun fit-Tibb (or Code of Laws in Medicine) represents the most important work of Ibn Sina, which is written in Arabic. As William Osler described it, “it is the most famous medical textbook ever written (1)”. As this book accumulates knowledge gathered through many civilisations until the time of Ibn Sina himself, it is considered a unique reference or document containing all medical knowledge.

Through his manner of explaining, Ibn Sina seemed quite close to presenting his findings in a similar manner to that which modern medical textbooks follow regarding classification, causes of diseases, epidemiology, symptoms and signs, treatment and prognosis. In this respect one may say that the excellence in its arrangement and comprehensiveness makes this book one of the most widespread in Muslim majority and European countries.

In the 15th century, the *Qanun* became known to the Europeans through the Latin translations of Gerard of Cremona, and remained in use in medical schools at Louvain and Montpellier until the 17th century. According to the Journal of UNESCO, October issue, 1980, *Al-Qanun* remained in use in Brussels University until 1909.

By the 12th century awareness in the Muslim world set in that these compendia were too large to be readily available for ready reference. Consequently, epitomes of *al-Qanun* were produced to make the ideas more accessible. This was followed by written commentaries clarifying the contents. The most popular of all the epitomes of *al-Qanun* was that called *Kitab al-Mujaz fil Tibb*, or "The Concise Book in Medicine". It was written in Syria by Ibn-al-Nafis, physician and anatomist, who died in 1288.

Ibn Sina begins his book *al-Qanun* by defining medicine by saying:

"Medicine is a science, from which one learns the states of the human body, with respect to what is healthy and what is not, in order to preserve good health when it exists, and restore it when it is lacking."

Al-Qanun consists of five books; the first is concerned with general medical principles; the second with *materia medica*; the third with diseases occurring in a particular part of the body; the fourth on diseases not specific to one bodily part (such as fevers), traumatic injuries such as fractures and dislocations of bones and joints; And the final book contains formulas giving recipes for compound remedies.

Ibn Sina devoted two treatises in the fourth book of *al-Qanun*, to fractures. The first treatise is entitled: "Fractures as a Whole", and the second is referred to as "Fractures of Every Bone Separately".

In the first treatise, he described the causes, types, forms, methods of treatment, and complications of fractures. While in the second treatise, he determined the special characteristics of fractures present in each bone.

The first treatise: Fractures as a whole

Ibn Sina defined a fracture as a loss of continuation in the bone (2). Then, he determined the types of fractures such as transverse, longitudinal, or comminuted. When he talked about symptoms and signs of a fracture, he considered the pain, swelling, and deformity of the limb to be of great importance to the diagnosis.

In this chapter, Ibn Sina distinguishes the fractures that reach the joint line. He says:

"If the fracture was at the joint line and healed, the movement of the joint could be difficult as the rigidity of the callus needs more time to become soft,"(3).

It is well known now that fractures which occupy the joint line, cause stiffness of that joint after they heal, unless appropriate physiotherapy is applied to the limb.

Factors that stimulate and inhibit bone healing

Ibn Sina mentions that fractures exhibited in children heal more rapidly than those present in adults. He determined the time span necessary for a bone to heal.

He said, for example, “a nose bone fracture needs 10 days to heal, a rib needs 20 days, a forearm needs 30 to 40 days, and a femur needs 50 to 120 days.” It is clear that these figures are similar to those written in contemporary medical textbooks.

At the end of the chapter, he outlined the factors that negatively affect bone healing. These include the lack of a splint at the site of the fracture, quickness in moving the affected limb, loss of blood (anemia), and the existence of a disease in the body (4). These factors, and others, are now considered to have a considerable role in delaying bone healing.

Principles of splinting the bone

In this chapter, Ibn Sina discusses treatment of a bone fracture by splinting it. He warned the physician against over-tightening the affected limb, which could cause gangrene.

In respect to what is now referred to as an open fracture, he highlighted the importance of taking care of the wound more than the fracture. If the fracture was complicated by a hematoma formation, Ibn Sina advises the bone setter to make an incision at the site of swelling to allow the blood to exit.

Ibn Sina also focuses on a very important issue in the treatment of comminuted fractures in this chapter. He mentions if the fracture is associated with a sequestrum, and is painful, it has to be mended and reduced in size. If this is impossible, the sequestrum has to be excised using a thin saw or by drilling multiple holes at its base. Whatever the method, the physician has to pay special attention so as to not injure an important structure. Sometimes the sequestrum is not visible, however remarking the discharge from the wound can better identify its position. In such cases, the wound must be enlarged to allow the removal of the sequestrum (5).

Recommendations to the bone setter

Before treating any fracture, Ibn Sina advised that the physician should inspect and examine the fracture accurately and splint it quickly. Should there be a delay, fracture reduction may become more difficult and further complications may also develop.

On the same hand, Ibn Sina drew attention to the necessity of not splinting the fracture immediately. He advised postponing it beyond the fifth day or more, until the swelling disappears. This is now named the “Theory of Delayed Splintage” with Professor George Perkins being considered the pioneer of this theory (6).

Fractures associated with a wound (open fractures)

In this chapter, Ibn Sina examined treating fractures associated with a wound. He stressed the necessity of not applying a splint to the wound; ointment should be applied at first, this would then permit the wound to be covered by a special dressing that would let out wound discharge, thus enabling the physician to apply medicine.

This method of treating open fractures as described by Ibn Sina is similar, in many aspects, to that used

today, withstanding the use of antiseptic procedures during the course of treatment.

Malunion fractures

What Ibn Sina meant by malunion fracture was a fracture that is joined in an unsuitable position, causing the limb to become deformed. To treat this case, he suggested breaking the bone at the site of old fracture once more and splinting it properly. If the callus is hard this method should be avoided otherwise a fracture may occur elsewhere. In such cases, Ibn Sina advised the bone setter to apply a material that softens the callus until the limb can be splinted in the correct manner.

Today, all types of malunions are treated surgically.

The second treatise - Fractures of every bone separately

Skull fracture

Ibn Sina clarified that a skull fracture may occur even if the skin above it is still intact. In such cases, a hematoma may develop under the skin. The physician should not omit fracture treatment however as this may lead to bone decay. In cases of patients complaining of tremors and memory loss, Ibn Sina advised the operator to make an incision at the site of the fracture to treat it. Subsequently, he outlined signs of skull fracture including unconsciousness, dizziness, and speech loss.

At the end of this chapter, Ibn Sina concludes:

"If the fracture is severely comminuted it should be completely excised, but if is linear and distended you should not widen the incision as no damage could result from the fracture."(7)

Mandible fracture

except in some modern special surgical techniques The method Ibn Sina described for treating these fractures resembles those used today,. In this respect, he said that if the fracture is on the right side and displaced internally, the physician must insert their left index and middle finger into the patient's mouth to elevate the fracture edge outward. The complete reduction could be identified by a good occlusion of teeth.

If the fracture is comminuted or associated with a wound, Ibn Sina said to make an incision at the fracture site, and remove any sequestrum that may be present. He advises the physician to suture the teeth using a gold wire in order to stabilise the correct position of the mandible. The patient is then asked to remain at rest and avoid speaking. Their diet should be liquids. The mandibular bone requires three weeks to heal and should hopefully be found filled with bone marrow.

Nose-bone fractures

Ibn Sina stated that a delay in treating a nose-bone fracture may lead to disfigurement of this bone, potentially causing anosmia to develop. As a result, he insisted on treating this fracture within the first 10 days. If the fracture is comminuted, and the reduction is impossible, the bone setter should incise the skin and remove all the comminuted bone.

Clavicle fracture

Ibn Sina's treatment of the clavicle fracture is extremely different from those known today. He considered

clavicle fractures difficult to splint. He described a long method to achieve a complete reduction. Today, this fracture is considered easy to treat; hence complete reduction is not required to achieve healing.

Shoulder fractures (fracture of scapula)

Ibn Sina said:

"The shoulder is rarely fractured in its broadest part, but its borders and sides are commonly affected . . . The most common signs are pain and crepitation on palpation, and the patient may complain of anaesthesia in the hand . . . This fracture is treated by pushing the shoulder from the anterior aspect as a trial to reduce it; otherwise, the physician has to use cupping glasses in order to tract the fractured part posteriorly . . . In cases of existence of some painful bone fragments, they should be excised. . . . After the treatment the patient is asked to sleep on the intact side."(8)

At present, all types of scapular fractures require no more treatment than rest until the pain subsides.

Fractures of the sternum

Ibn Sina classified this fracture into types:

1. An isolated splitting fracture, which is diagnosed by the existence of crepitation on palpation.
2. A fracture that is displaced anteriorly and may cause bad symptoms such as difficulty in breathing, dry cough, and, sometimes, haemoptysis.

The treatment of this fracture is similar to that of the shoulder.

Rib fractures

In this chapter, Ibn Sina stated that the seven true ribs are fractured at their lateral sides, while the false ribs are fractured at their medial sides. The diagnosis of a rib fracture is very easy to determine by palpation, which permits the physician to feel abnormal movement at the fracture site. The patient may complain of pleurisy and haemoptysis, also. The treatment is accomplished by using cupping glasses to tract fractured ribs. If the bone is compressing the diaphragm, the skin must be incised to carefully excise the bone in question.

Vertebral fractures

Perhaps owing to the rarity of information about these fractures at that time Here, Ibn Sina explores vertebral fractures briefly here. He attributed all this information to Paulus Egine (who was a famous surgeon from the Alexandria school who lived in the 7th century and wrote a medical book containing seven treatises on surgery and obstetrics, translated into Arabic by Hunayn ibn Ishaq).(9)

Ibn Sina subsequently drew the physician's attention to the danger of this type of fracture, which in extreme circumstances could cause death if the cervical vertebrae were involved.

To conclude, Ibn Sina described the method for reducing coccygeal fractures by inserting the left index finger into the patient's rectum.

Humeral fractures

Ibn Sina elucidated that this fracture often tilts outside, so the physician must reduce it according to this tilting. It should be stabilised by using three bandages; the first and third ascending while the second descends. The upper limb must be stabilised in an angular shape with a sling. It is better to stabilise it to the chest so as to prevent movement.

After seven to ten days, the bandages should be removed and replaced by applying suitable splints for another forty days.

Forearm fractures

Ibn Sina said: "Both ulnas or one of them may be fractured. The fracture of the inferior one is worse, while the fracture of the superior one is easier to treat." (10) At that time, the bones of the forearm were called the superior ulna (radius) and the inferior ulna (ulna).

Ibn Sina explained the methods for stabilising the fractured forearm. At first, Ibn Sina mentioned not to tighten the bandage too much; otherwise severe swelling of the fingers may develop. He then continued to state that neither should it be too loose so no swelling may appear at all. Succeeding this, he described a very important item that still occupies a considerable role in the field of treatment of forearm fractures, that is the necessity of not applying the splints so that they may extend beyond the base of the fingers. In which this may risk these fingers to become stiff.

After accurate reduction and complete stabilisation is achieved, Ibn Sina advised the physician to sling the affected forearm to the neck in an angular shaped position by using a wide rag. The rag should be able to cover the whole length of the forearm. Forearm fractures heal quickly (within 28 days).

Wrist fractures

Ibn Sina said:

"These bones rarely fracture, as they are very hard. And if they severely injured, dislocation may result, which could be treated as we had said in the dislocation section." (11)

It is well known today that wrist fractures are extremely rare, except for scaphoid fractures, which cannot be diagnosed without performing an X-ray on the wrist joint.

Finger bone fractures

In this chapter, Ibn Sina highlights that finger bones are more affected by dislocation than they are fractures. To treat finger fractures, the patient is seated on a high chair and is told to place their hands on a flat chair, an assistant should extend the fracture bones, and the physician is to reduce them with their thumb and index fingers.

Ibn Sina then directed the readers' attention to what is now referred to as "Bennet's fracture 1982" in which Bennet is believed to have said:

"If the fracture was in the thumb and was displaced inferiorly, then you have to use the broad bandage from above to prevent the occurrence of the hot tumour." (13)

Ibn Sina however outlined that if the fracture is located in the thumb, it should be bound to the hand; If it is in the index or small finger, it should be bound to the nearest finger.

Broad bones and hip fractures

This chapter represents the cases of central hip fracture-dislocation and fracture of the sacrum, which was called the broad bone at that time.

Ibn Sina noted a central hip fracture-dislocation rarely occurs. The injured patient may complain of severe pain and anaesthesia in his leg and thigh, resembling that of an arm or shoulder fracture.

In order to achieve a good reduction in broad bone fractures, Ibn Sina suggested that the physician should place the patient in a prone position, and two strong people should tract the patient's two thighs while two other people use splints to try to reduce the fracture and put on the bandages.

Femur fractures

Ibn Sina said: "If the femur fracture needs severe traction to reduce it to its normal position, which is convex in its lateral side and concave in its medial side, the traction should be placed upward to be more effective." (14)

He continued to outline that when this fracture occurs, the distal fragments displace anteriorly and outside because the femur is broader at that side.

After the reduction is achieved by applying severe traction, a bandage should be applied above the fracture and another one below it should the fracture be in the middle of the femur.

Femur fractures heal within fifty days. The most common complication is deviation at the fracture site.

Patella fractures

On patella fractures, Ibn Sina concluded:

"The patella is rarely fractured, but it is sprained frequently. The fracture is diagnosed by the presence of crepitation, which can be palpated or heard. In respect to treatment, the leg should be extended, then the patella be reduced. But if the fracture was comminuted, the fragments should be gathered first then reduced."(15)

Al-Razi (who lived prior to Ibn Sina's time) is considered the first who pointed to excision of the patella, preceding Brook (1903). (16)

Leg fractures

Ibn Sina stated that fractures of the small bone of a leg (which is now named the fibula) are easier to heal than fractures found present on the big bone (tibia). If the fracture is in the upper part of the tibia, the deformity is outside and anterior, hence making walking possible. If however the fracture is in the lower part of the tibia, the deformity is posterior and outside. If the fracture is present in both bones, the situation may seem more challenging to remedy and the deformity may occur at any direction.

Ibn Sina concluded that the physician should apply traction to reduce the fracture in the same method used for forearm fractures.

Talus fractures

In this chapter, Ibn Sina mentioned that the talus is protected against the fracture because it is solid and surrounded by structures that guard it. This bone may be dislocated.

Today, this fracture may happen rarely; its diagnosis is difficult unless an X-ray is performed.

Calcaneus fractures

With regard to calcaneus fractures, Ibn Sina stated:

"Calcaneus fracture is a bad case as its treatment is difficult. It occurs when a person falls down on his feet from a high place . . . It may cause severe signs like fever, confusion, tremor, and spasm . . . After Calcaneus fracture unites walking becomes difficult."(17)

This fracture is now entitled the "parachutist's fracture". The most important complication of this fracture is the difficulty it causes in walking, due to the development of osteoarthritis in the talocalcaneal joint after the union of this fracture.

Toe fractures

In this final chapter, Ibn Sina outlines that the treatment of toe fractures is like that of the fingers.

Conclusion

A survey was conducted to find out the most significant points related to fractures as described by Ibn Sina in his medical book, *al-Qanun-fit-Tibb*.

From this survey we can conclude:

1. Ibn Sina played an important role in keeping the medical heritage that developed over thousands of years. His medical book, *al-Qanun-fit-Tibb*, represents a unique reference as the knowledge mentioned was accumulated through many civilisations until the age of Ibn Sina. The document contains general medical knowledge and traumatology in particular.
2. The manner in which Ibn Sina outlined his case on medicine could be said to be very close to the way modern medical textbooks follow. In his prelude, he discusses fractures in general. Later, he described their cause, types, forms, methods of treatment, and complications. Finally, he explored the fractures that occur in every bone.

In this respect, one can say that the excellence in its arrangement and comprehensiveness made *al-Qanun* the most widely used medical textbook in Muslim governed and European countries until the 17th century.

3. Ibn Sina drew attention to the necessity of not splinting the fracture immediately, advising the physician to postpone it beyond the fifth day. In the present day, this is referred to as the "Theory of Delayed Splintage"

and Professor George Perkins is considered the pioneer of this theory.

4. Ibn Sina described what is now named "Bennet's fracture 1882." We know that neither al-Razi preceding him, nor Ibn al-Quf after him, had described this type of fracture. This leads us to draw the conclusion that Ibn Sina is considered the first who described this fracture nearly one thousand years prior to Bennet.

A famous saying in Europe and beyond outlines: "Anyone who wants to be a good doctor must be an Avicennist." A word of truth was written by the European physician De Pourc who declared: Medicine was absent until Hippocrates created it, dead until Galen revived it, dispersed until Rhazes (al-Razi) collected it, and deficient until Avicenna (Ibn Sina) completed it.

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